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(54) Title: METHOD AND INSTALLATIONS FOR TREATING EFFLUENTS IN SMALL COMMUNITIES

(54) Titre: PROCEDE ET INSTALLATIONS DE TRAITEMENT D'EFFLUENTS DE PETITES COLLECTIVITES

(57) Abstract

The invention concerns a method for treating effluents in small communities, that is communities consisting of about 200 to 2000 inh.eq (inhabitant equivalent), characterised in that it consists in: carrying out a biological treatment of the effluent using a trickling filter eliminating matters suspended in the treated effluent, and, simultaneously performing a treatment of the sludge by filtering-composting on filters planted with reeds.

(57) Abrégé

Procédé de traitement d'effluents de petites collectivités, c'est-à-dire de 200 à 2000 eH (équivalent habitant) environ, caractérisé en ce qu'il consiste à: effectuer un traitement biologique de l'effluent à l'aide d'un lit bactérien; et réaliser une élimination des matières en suspension dans l'effluent ainsi traité et, simultanément, un traitement des boues par filtration-compostage sur des filtres plantés de roseaux.

Process and plants for the treatment of effluents from small communities

The present invention generally relates to the treatment of effluents from what it is convenient to refer to as small communities, that is to say communities having from 500 to 2 000 Ie (inhabitant equivalent).

France has approximately 36 000 communes, 31 300 of which have more than 200 inhabitants and less than 2 000 inhabitants, which communes represent a population of the order of 15 000 000 inhabitants, constituting approximately 25% of the total population of France.

The total number of purification plants in France is approximately 12 000, and more than 60% have a size of less than 2 000 Ie.

These purification plants for small communities generally employ a biological treatment with activated sludge, although this technique is entirely unsuited to purification plants of such a size, in particular because of the high capital cost and especially excessive operating costs. Furthermore, the efficiency of such plants is often mediocre. A person skilled in the art knows that the biological treatment of effluents with activated sludge must be reserved for the biggest plants in the context of discharge into a particularly sensitive environment.

The problem which has to be solved lies in the development of a technique suited to such small plants for financially acceptable operating costs. In particular, the objective is to achieve, for effluent treatment plants with a capacity of between 500 and 2 000 Ie, an operating cost which is reduced by 50 to 70% with respect to that of plants employing a biological treatment with activated sludge.

In order to solve the abovementioned problem, the invention provides for the introduction of a novel treatment route which is inexpensive in terms of capital and operating costs and which, of course, meets the discharge requirements of the decree of 21 June

1996 (Official Gazette of the French Republic of 9 August 1996) relating to facilities for the treatment of waste water from small communities, that is to say of 200 to 2 000 Ie. (> 12 kg BOD_5 and < 120 kg BOD_5/d).

According to Art. 13 of this decree, the following performance is expected for a biological treatment:

- either a minimum efficiency of 60% with respect to the BOD_5 or the COD,
- or a maximum concentration in the treated effluent of 35 mg BOD_5/l.

These requirements are, of course, met by the process and the plant which are subject-matters of the present invention.

Consequently, this invention firstly relates to a process for the treatment of effluents from small communities, that is to say of approximately 500 to 2 000 Ie (Inhabitant equivalent), employing filters planted with reeds, characterized in that it consists:

- in carrying out a biological treatment of the effluent using a trickling filter, and
- in removing the suspended matter in the effluent thus treated and simultaneously treating the sludge by filtration-composting on filters planted with reeds, the latter preferably being Phragmites australis.

The invention also relates to a plant for the purpose of the implementation of the process defined above, this plant being characterized in that it comprises:

- a trickling filter comprising at least one stage in which the effluent to be treated is received, and
- at least one filtration-composting compartment fed from the trickling filter, each of the said compartments comprising successive layers of filler materials and of sand and their upper surfaces being planted with reeds, in particular with Phragmites australis.

As is understood, the discharge requirements mentioned in the decree of 21 June 1996 are observed by

the invention by employing a trickling filter, that is to say a treatment route of the fixed culture type with a low contact time, the feeding with effluents being carried out directly without passing into a preliminary clarification tank. The trickling filter technique, in its modern conception (absence of preliminary clarification tank, treatment route such as screening, "feeding-recirculation" pumping station, plastic-packed bed), makes possible an economical treatment of the effluents as a result of a low energy consumption (close to half that with activated sludge, for an equivalent performance). The capital cost remains advantageous for a treatment limited to removing pollution by carbon compounds.

Depending upon the restrictions of the natural environment, it is possible to envisage a nitrification treatment of the ammoniacal nitrogen by increasing the size of the trickling filter or by providing a second stage. Thus, the scale of the first stage must be defined, according to the invention, according to the discharge stipulations and the treatments for removal of pollution from the effluent to be carried out.

The effluents thus treated are subsequently freed from suspended matter by passing through filtration compartments planted with reeds, in which is also carried out the treatment of the sludge by rhizocomposting. It is also possible to count on an additional treatment of the effluents in the filtering core of the filtration compartments.

According to the present invention, the pretreatment of the effluents is restricted to a fine sieving (3 mm mesh) or a screening (6 mm mesh) which makes it possible to remove various types of waste. It is not necessary to employ a degritting-degreasing system, given that the particles (organic matter, including grease, sand) with a particle size smaller than the sieving or screening mesh have no effect on the treatment route (trickling filter + filter-rhizocomposting).

It may be indicated, as a nonlimiting implementational example, that a device produced according to the present invention comprises a first lift-recirculation station (equipped with two pumps, one of which is a spare) continually feeding the trickling filter. The latter is of the type with PVC plastic packing (cross current, specific surface area 165 m^2/m^3) with a height of approximately 5 metres, the mean hydraulic load being of the order of 2 m/h. A partition is provided in this station in order to pump first and foremost the crude effluents to be treated, with an additional contribution of treated effluents in order to ensure the hydrodynamic conditions of the trickling filter.

The effluents treated on the trickling filter arrive at a second pumping station by overflow of the lift-recirculation station, this second pumping station, equipped with two pumps, one of which is a spare, exhibiting a differential volume sufficient to allow batchwise feeding of the filtration-composting compartments (batches of 5 to 15 cm, over 10 to 20 minutes).

According to this implementational example of the present invention, the treatment plant comprises filtration-composting compartments, the latter numbering at least three. The surface area of these compartments is from 0.4 to 1 m^2 per Ie and the maximum surface area per unit is from 100 to 150 m^2. The feeding of the bed of one compartment corresponds to each batch. According to the present invention, the second pumping station is intended to be automatically controlled, in order to ensure feeding of all the filtration-composting compartments in rotation, with at least one compartment continuously at rest for a week.

By way of example, the filtration-composting compartments can be produced from pointed concrete boundary panels and piles exhibiting a height of approximately 2 metres (which results in a free height of 1.50 m) and a maximum width of 5 m, in order to

allow access for removing sludge. The foundation of the compartments is composed of a plastic sheet on which are positioned drains, in order to provide for the recovery of the treated effluents, in a layer of pebbles (h = approximately 20 cm and particle size of the order of 30/80 mm). This layer of pebbles is covered successively with a layer of gravel (h = approximately 10 cm) and with a layer of sand (h = 40 cm, washed sand devoid of fines).

A biological treatment of the fixed culture type is carried out on the layer of sand and, with the mechanical effect of the filtration, it is possible to obtain a good purifying performance.

The surfaces of the filtration-composting compartments are planted with reeds (Phragmites australis), the intense root growth of which promotes the circulation of air and provides for composting of the sludge. Under normal operation, the dry content of the sludge is approximately 12% and the veiling level of the sludge in the compartments increases by 20 to 30 cm per year. After operating for approximately five years, it is necessary to provide for the extraction of the accumulated sludge (compost). After a period of rest of the order of one to two weeks, the compost is extracted and is provisionally stored, for drying, on a neighbouring area of ground. After drying for several weeks, it is possible to obtain a fully stabilized product exhibiting a dry content of greater than 30%.

The scale of the various components of purification plants according to the present invention, for various sizes of plant, is given in Table 1 below by way of example.

Table 1

BASIC DATA						
Nominal capacity	Ie	200	500	1 000	1 500	2 000
Daily throughput	m^3/d	30	75	150	225	300
BOD_5 nd Raw water	kg/d	12	30	60	90	120
DISCHARGE OBJECTIVE						
BOD_5 ad2 · discharge targeted (trickling filter outlet)	mg/l	35	35	35	35	35
FINE SIEVING (type Aquagard 3 mm)						
Waste production	kg/year	438	1 095	2 190	3 285	4 380
RECIRCULATION PUMPING STATION						
Throughput per unit	m^3/h	8.0	20	40	60	80
Pump number	u	2.0	2.0	2.0	2.0	2.0
TRICKLING FILTER						
Filter efficiency	% (ad2 Raw water)	87	87	87	87	87
Expanded surface area to be provided	m^2	2 600	6 600	13 000	20 000	26 000
Diameter	m	3.2	4.1	5.1	6.2	6.4
Minimum throughput of the recirculation pump	m^3/h	8.0	20	40	60	80
Production of nonstabilized sludge	kg SS/d	13.4	33.5	66.9	100.4	133.9
SECONDARY LIFT STATION						
Throughput for pumping to the compartments	m^3/h	15	38	56	56	56
FILTRATION, RHIZOCOMPOSTING						
Rhizocomposting compartment number	u	3	3	4	6	8
Surface area per unit of the compartments	m^2	30	74	112	112	112
Compost production	$m^3/year$	16	40	79	119	159

As regards the use of space, the total surface areas which have to be employed, on the one hand in the previous techniques and on the other hand in a plant according to the present invention employing a trickling filter combined with filtration-rhizocomposting compartments, are shown in Table 2 below. In this table, "DG" denotes a draining grating, for example as defined in FR-A-2 754 191.

Table 2

Capacity	Ie	200	500	1 000	1 500	2 000
Buried filters	m^2	500	1 175	2 300	3 425	4 550
Infiltration Percolation	m^2	750	1 725	3 350	4 975	6 600
Natural lagooning	m^2	4 500	11 250	22 500	33 750	45 000
Trickling filters + Clarif + DG + Silo	m^2	300	750	1 500	2 250	3 000
Activated sludge + Clarif + DG + Silo	m^2	200	500	1 000	1 500	2 000
Filters planted with reeds, two stages	m^2	600	1 500	3 000	4 500	6 000
Trickling filter + Rhizocomposting filter	**m^2**	**140**	**350**	**700**	**1 050**	**1 400**

It clearly emerges, on examining this Table 2, that the technique provided by the invention occupies very little space, which gives it a significant advantage in comparison with the other techniques, in particular in comparison with lagooning and with any technique in which filtration is involved in the treatment of the effluents.

Table 3 allows the capital costs of the plants according to the invention to be compared with those of the plants according to the other treatment routes. The values shown in Table 3 correspond to relative costs expressed with respect to the most expensive scenario, arbitrarily assessed at 1 000.

Table 3

Capacity	200 Ie	500 Ie	1 000 Ie	1 500 Ie	2 000 Ie
Buried filters	1 000	847			
Natural lagooning	840	445	290	245	230
Infiltration Percolation	735	460	260	200	185
Trickling filters + Clarif + DG + Silo	795	380	290	245	230
Activated sludge + Clarif + DG + Silo	**655**	**410**	320	275	**260**
Filters planted with reeds (2 stages)	550	380	275	245	230
Trickling filter + Rhizo-composting filter	**520**	**320**	**260**	**230**	**215**

The price ratios mentioned above are given by way of indication, with the objective of observing the abovementioned standards, apart from the lagooning technique (specific standard on samples of the prefiltered discharge). As regards the activated sludge technique, reference is made to a treatment of the prolonged aeration type. For plants with a capacity of less than 500 Ie, no account is taken of dynamic thickening (for example "DG" or other similar techniques).

It clearly emerges from Table 3 that the technique introduced by the present invention is particularly advantageous for plants of less than or equal to 1 000 Ie in size. Furthermore, it should be noted that the cost of the land was not taken into consideration in these cost evaluations, which may prove to be a determining parameter in the choice of a solution which will be adopted. In this respect, the technique according to the present invention has decisive advantages in the case of a high price of land.

Table 4 below allows the operating costs of purification plants of different capacities according to the present invention to be compared with those of purification plants of the same capacity according to the previous techniques. The approximate operating costs per year and per inhabitant equivalent (expressed as a ratio with respect to the highest operating cost) are given in Table 4.

Table 4

Capacity	200 Ie	500 Ie	1 000 Ie	1 500 Ie	2 000 Ie
Activated sludge	**1.00**	**0.70**	**0.44**	**0.39**	**0.34**
Trickling filter + Rhizofilter	0.66	0.43	0.26	0.22	0.19
Natural lagooning	0.36	0.20	0.17	0.15	0.14
Infiltration Percolation	0.32	0.23	0.21	0.20	0.19
Filters planted with reeds (2 stages)	0.23	0.16	0.15	0.14	0.13
Trickling filter + Rhizo-composting filter	**0.44**	**0.21**	**0.17**	**0.13**	**0.11**

It clearly emerges from reading the preceding description that the invention introduces a process and a plant for the treatment of effluents with an optimized scale which makes it possible to reduce the capital and operating costs, while benefiting from the advantages of each of the treatment stations (trickling filter and rhizocomposting filters), this being particularly true as regards the second station, in which the filtration of the effluents originating from the trickling filter and the composting of the sludge phase are simultaneously provided.

The process and the device which are a subject-matter of this invention make it possible to obtain a stabilized and non-fermentable sludge which is convenient to employ, in particular in carrying out

backfilling operations, in agricultural applications, and the like.

Of course, it remains that the present invention is not limited to the implementational examples described and/or represented here but that it encompasses all the alternative forms thereof coming within the scope of the invention as defined by the claims.

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. Process for the treatment of effluents from communities of 500 to 2000 Ie (inhabitant equivalent), by employing filters planted with reeds, wherein it comprises:

carrying out a biological treatment of the effluent using a trickling filter, and

removing the suspended matter in the effluent thus treated and simultaneously treating the sludge by filtration-composting on filters planted with Phragmites australis.

2. Plant for the implementation of the process according to claim 1, wherein it comprises:

a trickling filter comprising at least one stage in which the effluent to be treated is received, and

at least one filtration-composting compartment fed from the trickling filter, each of the said compartments comprising successive layers of filler materials and of sand and their upper surfaces being planted with Phragmites australis.

3. Plant according to claim 2, wherein the dimensions of the trickling filter are determined according to the treatments for removal of pollution from the effluent to be carried out.

4. Plant according to claim 2, wherein it comprises at least three filtration-composting compartments.

5. Plant according to either one of claims 2 and 4, wherein the maximum surface area per unit of each of the filtration compartments is of the order of 100 to 150 m^2.

6. Plant according to any one of claims 2, 4 and 5, wherein the surface area of the filtration-composting compartments is from approximately 0.4 to 1 m^2 per Ie.

7. Plant according to any one of claims 2 to 6, wherein automatic control is additionally provided in order to ensure feeding of the filtration-composting compartments in rotation.

8. Device according to any one of claims 2 to 7, wherein it comprises a means for the pre-treatment of the effluents before they are passed onto the trickling filter for the purpose of removing waste.

9. Device according to claim 8, wherein the said means is composed of a sieving system having a mesh size of the order of 3 mm.

10. Device according to claim 8, wherein the said means is composed of a screening system exhibiting a mesh size of the order of 6 mm.

11. Device substantially as hereinbefore described with reference to the examples

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